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L11: Entry 2 of 3 File: USPT May 4, 1993

DOCUMENT-IDENTIFIER: US 5207087 A
TITLE: Sensor calibrator and test apparatus

Abstract Text (1):
Methods and apparatuses for testing chemical concentrations of fluids (liquids, gases) and for sensors used in such tests; methods and apparatuses for calibrating sensors and, in particular, for calibrating optical fiber sensors, the apparatus in one aspect including a body member with a cavity having gas inlet(s) and outlet(s) and a microporous tube therein for holding a fluid into which an optical probe sensor is insertable.

Brief Summary Text (8):
In-line extracorporeal sensors are calibrated by bubbling a stream of gas through an aqueous solution in contact with the sensors. The sensor is then separated from the test solution (blood) by the addition of a semipermeable membrane to control infection.

Brief Summary Text (15):
The present invention, in another embodiment, discloses a device for calibrating sensors that includes a fluid reservoir and a channel for a moving fluid stream containing the substance to be sensed in known concentration (e.g., but not limited to mixed gases), the two fluids being separated by a selectively permeable membrane. The sensor is placed in the reservoir close to the permeable membrane. The target substance diffuses across the membrane and reaches chemical equilibrium with the sensor environment. Provision of multiple compositions of the moving fluid produces a sequence of different equilibria near the sensor which provide points of reference for calibrating the response of the sensor.

Brief Summary Text (17):
In certain embodiments of this invention, sensor sterility is preserved by the use of one container at constant volume. In addition the volume of fluid near the sensor may be minimized; and the distance between the sensor and the known fluid and the permeability and thickness of the separating membrane may be optimized so that the time required for calibration is reduced as compared with respect to the time required for devices using bubbles and/or convection for equilibration. The moving fluid may be a liquid, with permeability of the separatory membranes selected to allow diffusion of soluble substances such as ions or other compounds. The separatory membrane may be a flat sheet, a pleated sheet, or sheets with fluid flowing on either side. A pump may be used to circulate the known fluids and/or the test fluid.

Brief Summary Text (28):
Calibrators according to the present invention can be used with the sensors disclosed in pending U.S. patent application Ser. No. 07/526,822 filed on May 22, 1990 and entitled "Optical Probe" which is incorporated herein for all purposes and a copy of which is submitted with the application for this patent.

Detailed Description Text (8):
It is preferred that the microporous material be thin silicone rubber, nitrocellulose, or an expanded polymer such as expanded Teflon (TM) material,

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expanded polyethylene, or expanded polypropylene In the embodiment of FIG. 1 it is preferred that the wall thickness of the material of the tube 20 be between about 0.025 millimeters to about 0.2 millimeters. It is within the scope of this invention to flow a liquid into the cavity 30 and to utilized a membrane that permits only certain ions or chemicals in the liquid (e.g., but not limited to sodium, blood enzymes, potassium) to pass through to affect a sensor probe.

Detailed Description Text (12):
As shown, in FIGS. 4a and 4b, in a calibrator 410 according to the present invention compressed gases are allowed to flow from reservoirs 421 and 422 controlled by a valve 423 and to diffuse across a microporous membrane 424 which is contained in a gas exchange chamber 425. Calibration fluid 427 is circulated about a sensor probe 428 by means of a pump device, e.g. a diaphragm pump 429. The calibration fluid 427 flows in a channel 430 which extends through the chamber 425 and which communicates with the pump 429. The sensor probe 428 is sealingly disposed through an opening 431 in a housing 432 of the device. Gas exits the chamber 425 through a gas outlet 433.

Detailed Description Text (13):
Referring now to FIGS. 5a, 5b, and 5c, a calibrator 530 according to the present invention has an outer body 531 with a pleated hydrophobic microporous element 532 disposed therein. A female luer connector 533 is sealingly secured in an opening 534 of the body 531. A probe (not shown) may be inserted into the plug 533 and into a channel 535 in the pleated microporous hydrophobic membrane element 532. Gas of a known concentration is introduced into the body 531 through a hole 536 to diffuse across the element 532 and interact with the sensor probe. Gas exits from the body 531 through a hole 537.

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